

$\Lambda(1520) \ 3/2^-$

 $I(J^P) = 0(\frac{3}{2}^-)$ Status: ****

Discovered by FERRO-LUZZI 62; the elaboration in WATSON 63 is the classic paper on the Breit-Wigner analysis of a multichannel resonance.

The measurements of the mass, width, and elasticity published before 1975 are now obsolete and have been omitted. They were last listed in our 1982 edition Physics Letters **111B** 1 (1982).

Production and formation experiments agree quite well, so they are listed together here.

NODE=B038

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$\Lambda(1520)$ MASS

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|---------------------------------|------|--------------------|------|--|
| 1519.5 ±1.0 OUR ESTIMATE | | | | |
| 1519.53±0.19 OUR AVERAGE | | | | |
| 1520.4 ±0.6 ±1.5 | | ¹ QIANG | 10 | SPEC $ep \rightarrow e'K^+X$ (fit to X) |
| 1517.3 ±1.5 | 300 | BARBER | 80D | SPEC $\gamma p \rightarrow \Lambda(1520)K^+$ |
| 1517.8 ±1.2 | 5k | BARLAG | 79 | HBC K^-p 4.2 GeV/c |
| 1520.0 ±0.5 | | ALSTON-... | 78 | DPWA $\bar{K}N \rightarrow \bar{K}N$ |
| 1519.7 ±0.3 | 4k | CAMERON | 77 | HBC K^-p 0.96–1.36 GeV/c |
| 1519 ±1 | | GOPAL | 77 | DPWA $\bar{K}N$ multichannel |
| 1519.4 ±0.3 | 2000 | CORDEN | 75 | DBC K^-d 1.4–1.8 GeV/c |

¹QIANG 10 gets 1518.8 MeV for the pole mass (no errors given).

NODE=B038M

NODE=B038M

→ UNCHECKED ←

NODE=B038M;LINKAGE=QI

$\Lambda(1520)$ WIDTH

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------------------------|------|---------------------|------|--|
| 15.6 ±1.0 OUR ESTIMATE | | | | |
| 15.64±0.29 OUR AVERAGE | | | | |
| 18.6 ±1.9 ±1.0 | | ² QIANG | 10 | SPEC $ep \rightarrow e'K^+X$ (fit to X) |
| 16.3 ±3.3 | 300 | BARBER | 80D | SPEC $\gamma p \rightarrow \Lambda(1520)K^+$ |
| 16 ±1 | | GOPAL | 80 | DPWA $\bar{K}N \rightarrow \bar{K}N$ |
| 14 ±3 | 677 | ³ BARLAG | 79 | HBC K^-p 4.2 GeV/c |
| 15.4 ±0.5 | | ALSTON-... | 78 | DPWA $\bar{K}N \rightarrow \bar{K}N$ |
| 16.3 ±0.5 | 4k | CAMERON | 77 | HBC K^-p 0.96–1.36 GeV/c |
| 15.0 ±0.5 | | GOPAL | 77 | DPWA $\bar{K}N$ multichannel |
| 15.5 ±1.6 | 2000 | CORDEN | 75 | DBC K^-d 1.4–1.8 GeV/c |

²QIANG 10 gets 17.2 MeV for the pole width (no errors given).

³From the best-resolution sample of $\Lambda\pi\pi$ events only.

NODE=B038W

NODE=B038W

→ UNCHECKED ←

NODE=B038W;LINKAGE=QI

NODE=B038;LINKAGE=A

$\Lambda(1520)$ DECAY MODES

| Mode | Fraction (Γ_i/Γ) |
|---|--------------------------------|
| $\Gamma_1 \ N\bar{K}$ | 45 ± 1% |
| $\Gamma_2 \ \Sigma\pi$ | 42 ± 1% |
| $\Gamma_3 \ \Lambda\pi\pi$ | 10 ± 1% |
| $\Gamma_4 \ \Sigma(1385)\pi$ | |
| $\Gamma_5 \ \Sigma(1385)\pi(\rightarrow \Lambda\pi\pi)$ | |
| $\Gamma_6 \ \Lambda(\pi\pi)_S\text{-wave}$ | |
| $\Gamma_7 \ \Sigma\pi\pi$ | 0.9 ± 0.1% |
| $\Gamma_8 \ \Lambda\gamma$ | 0.85 ± 0.15% |
| $\Gamma_9 \ \Sigma^0\gamma$ | |

NODE=B038215;NODE=B038

DESIG=1;OUR EST

DESIG=2;OUR EST

DESIG=3;OUR EST

DESIG=7;OUR EST

DESIG=8;OUR EST

DESIG=9;OUR EST

DESIG=6;OUR EST

DESIG=4;OUR EST

DESIG=5;OUR EST

CONSTRAINED FIT INFORMATION

An overall fit to 9 branching ratios uses 26 measurements and one constraint to determine 6 parameters. The overall fit has a $\chi^2 = 17.6$ for 21 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients $\langle \delta x_i \delta x_j \rangle / (\delta x_i \delta x_j)$, in percent, from the fit to the branching fractions, $x_i \equiv \Gamma_i / \Gamma_{\text{total}}$. The fit constrains the x_i whose labels appear in this array to sum to one.

| | | | | | |
|-------|-------|-------|-------|-------|-------|
| x_2 | -64 | | | | |
| x_3 | -32 | -34 | | | |
| x_7 | -4 | -3 | -1 | | |
| x_8 | -8 | -7 | -3 | 0 | |
| x_9 | -24 | -21 | -10 | -1 | -1 |
| | x_1 | x_2 | x_3 | x_7 | x_8 |

$\Lambda(1520)$ BRANCHING RATIOS

See "Sign conventions for resonance couplings" in the Note on Λ and Σ Resonances.

NODE=B038220

NODE=B038220

$\Gamma(N\bar{K})/\Gamma_{\text{total}}$

| VALUE | DOCUMENT ID | TECN | COMMENT | Γ_1/Γ |
|---|-------------|------|--------------------------------------|-------------------|
| 0.45 ± 0.01 OUR ESTIMATE | | | | |
| 0.447 ± 0.007 OUR FIT | | | Error includes scale factor of 1.2. | |
| 0.455 ± 0.011 OUR AVERAGE | | | | |
| 0.47 ± 0.02 | GOPAL | 80 | DPWA $\bar{K}N \rightarrow \bar{K}N$ | |
| 0.45 ± 0.03 | ALSTON-... | 78 | DPWA $\bar{K}N \rightarrow \bar{K}N$ | |
| 0.448 ± 0.014 | CORDEN | 75 | DBC $K^- d$ 1.4–1.8 GeV/c | |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● | | | | |
| 0.47 ± 0.01 | GOPAL | 77 | DPWA See GOPAL 80 | |
| 0.42 | MAST | 76 | HBC $K^- p \rightarrow \bar{K}^0 n$ | |

NODE=B038R6

NODE=B038R6

→ UNCHECKED ←

$\Gamma(\Sigma\pi)/\Gamma_{\text{total}}$

| VALUE | DOCUMENT ID | TECN | COMMENT | Γ_2/Γ |
|---|-------------|------|-------------------------------------|-------------------|
| 0.42 ± 0.01 OUR ESTIMATE | | | | |
| 0.420 ± 0.007 OUR FIT | | | Error includes scale factor of 1.2. | |
| 0.423 ± 0.011 OUR AVERAGE | | | | |
| 0.426 ± 0.014 | CORDEN | 75 | DBC $K^- d$ 1.4–1.8 GeV/c | |
| 0.418 ± 0.017 | BARBARO-... | 69B | HBC $K^- p$ 0.28–0.45 GeV/c | |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● | | | | |
| 0.46 | KIM | 71 | DPWA K-matrix analysis | |

NODE=B038R7

NODE=B038R7

→ UNCHECKED ←

$\Gamma(\Sigma\pi)/\Gamma(N\bar{K})$

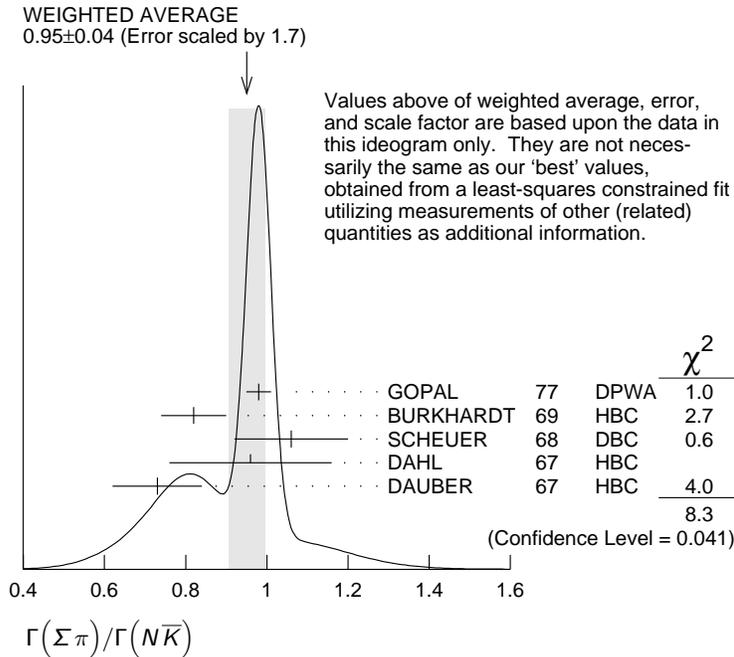
| VALUE | DOCUMENT ID | TECN | COMMENT | Γ_2/Γ_1 |
|---|--------------------|------|---|---------------------|
| 0.940 ± 0.026 OUR FIT | | | Error includes scale factor of 1.3. | |
| 0.95 ± 0.04 OUR AVERAGE | | | Error includes scale factor of 1.7. See the ideogram below. | |
| 0.98 ± 0.03 | ⁴ GOPAL | 77 | DPWA $\bar{K}N$ multichannel | |
| 0.82 ± 0.08 | BURKHARDT | 69 | HBC $K^- p$ 0.8–1.2 GeV/c | |
| 1.06 ± 0.14 | SCHEUER | 68 | DBC $K^- N$ 3 GeV/c | |
| 0.96 ± 0.20 | DAHL | 67 | HBC $\pi^- p$ 1.6–4 GeV/c | |
| 0.73 ± 0.11 | DAUBER | 67 | HBC $K^- p$ 2 GeV/c | |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● | | | | |
| 1.06 ± 0.12 | BERTHON | 74 | HBC Quasi-2-body σ | |
| 1.72 ± 0.78 | MUSGRAVE | 65 | HBC | |

NODE=B038R1

NODE=B038R1

⁴ The $\bar{K}N \rightarrow \Sigma\pi$ amplitude at resonance is $+0.46 \pm 0.01$.

NODE=B038;LINKAGE=B



$\Gamma(\Lambda\pi\pi)/\Gamma_{\text{total}}$

Γ_3/Γ

| VALUE | DOCUMENT ID | TECN | COMMENT |
|----------------------------------|-------------------|----------|-------------------------------------|
| 0.10 ± 0.01 OUR ESTIMATE | | | |
| 0.095 ± 0.005 OUR FIT | | | Error includes scale factor of 1.2. |
| 0.096 ± 0.008 OUR AVERAGE | | | Error includes scale factor of 1.6. |
| 0.091 ± 0.006 | CORDEN | 75 DBC | $K^- d$ 1.4–1.8 GeV/c |
| 0.11 ± 0.01 | ⁵ MAST | 73B IPWA | $K^- p \rightarrow \Lambda\pi\pi$ |

NODE=B038R11
NODE=B038R11
→ UNCHECKED ←

⁵ Assumes $\Gamma(N\bar{K})/\Gamma_{\text{total}} = 0.46 \pm 0.02$.

NODE=B038;LINKAGE=J

$\Gamma(\Lambda\pi\pi)/\Gamma(N\bar{K})$

Γ_3/Γ_1

| VALUE | DOCUMENT ID | TECN | COMMENT |
|---|-------------|---------|-------------------------------------|
| 0.213 ± 0.012 OUR FIT | | | Error includes scale factor of 1.2. |
| 0.202 ± 0.021 OUR AVERAGE | | | |
| 0.22 ± 0.03 | BURKHARDT | 69 HBC | $K^- p$ 0.8–1.2 GeV/c |
| 0.19 ± 0.04 | SCHEUER | 68 DBC | $K^- N$ 3 GeV/c |
| 0.17 ± 0.05 | DAHL | 67 HBC | $\pi^- p$ 1.6–4 GeV/c |
| 0.21 ± 0.18 | DAUBER | 67 HBC | $K^- p$ 2 GeV/c |
| • • • We do not use the following data for averages, fits, limits, etc. • • • | | | |
| 0.27 ± 0.13 | BERTHON | 74 HBC | Quasi-2-body σ |
| 0.2 | KIM | 71 DPWA | K-matrix analysis |

NODE=B038R2
NODE=B038R2

$\Gamma(\Sigma\pi)/\Gamma(\Lambda\pi\pi)$

Γ_2/Γ_3

| VALUE | DOCUMENT ID | TECN | COMMENT |
|------------------------------|---------------|--------|-------------------------------------|
| 4.42 ± 0.25 OUR FIT | | | Error includes scale factor of 1.2. |
| 3.9 ± 0.6 OUR AVERAGE | | | |
| 3.9 ± 1.0 | UHLIG | 67 HBC | $K^- p$ 0.9–1.0 GeV/c |
| 3.3 ± 1.1 | BIRMINGHAM | 66 HBC | $K^- p$ 3.5 GeV/c |
| 4.5 ± 1.0 | ARMENTEROS65C | HBC | |

NODE=B038R3
NODE=B038R3

$\Gamma(\Sigma(1385)\pi)/\Gamma_{\text{total}}$

Γ_4/Γ

| VALUE | DOCUMENT ID | TECN | COMMENT |
|----------------------|-------------|--------|-----------------------------------|
| 0.041 ± 0.005 | CHAN | 72 HBC | $K^- p \rightarrow \Lambda\pi\pi$ |

NODE=B038R10
NODE=B038R10

$\Gamma(\Sigma(1385)\pi(\Rightarrow \Lambda\pi\pi))/\Gamma(\Lambda\pi\pi)$

Γ_5/Γ_3

The $\Lambda\pi\pi$ mode is largely due to $\Sigma(1385)\pi$. Only the values of $(\Sigma(1385)\pi) / (\Lambda\pi\pi)$ given by MAST 73B and CORDEN 75 are based on real 3-body partial-wave analyses. The discrepancy between the two results is essentially due to the different hypotheses made concerning the shape of the $(\pi\pi)_S$ -wave state.

NODE=B038R9
NODE=B038R9

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-------------|-----|-------------------|----------|-----------------------------------|
| 0.58 ± 0.22 | | CORDEN | 75 DBC | $K^- d$ 1.4–1.8 GeV/c |
| 0.82 ± 0.10 | | ⁶ MAST | 73B IPWA | $K^- p \rightarrow \Lambda\pi\pi$ |

NODE=B038R9

• • • We do not use the following data for averages, fits, limits, etc. • • •

<0.44 90 WIELAND 11 SPHR $\gamma p \rightarrow K^+ \Lambda(1520)$
 0.39±0.10 7 BURKHARDT 71 HBC $K^- p \rightarrow (\Lambda\pi\pi)\pi$

⁶ Both $\Sigma(1385)\pi DS_{03}$ and $\Sigma(\pi\pi) DP_{03}$ contribute.

⁷ The central bin (1514–1524 MeV) gives 0.74 ± 0.10 ; other bins are lower by 2-to-5 standard deviations.

NODE=B038;LINKAGE=I
 NODE=B038;LINKAGE=G

$\Gamma(\Lambda(\pi\pi)S\text{-wave})/\Gamma(\Lambda\pi\pi)$

| VALUE | DOCUMENT ID | TECN | COMMENT | Γ_6/Γ_3 | |
|------------------|-------------|------|---------|-----------------------|------------------------------|
| 0.20±0.08 | CORDEN | 75 | DBC | $K^- d$ 1.4–1.8 GeV/c | NODE=B038R12 NODE=B038R12 |

$\Gamma(\Sigma\pi\pi)/\Gamma_{\text{total}}$

| VALUE | DOCUMENT ID | TECN | COMMENT | Γ_7/Γ | |
|----------------------------------|---------------------|------|---------|----------------------------------|----------------------------|
| 0.009 ±0.001 OUR ESTIMATE | | | | | NODE=B038R8 NODE=B038R8 |
| 0.0086±0.0005 OUR FIT | | | | | → UNCHECKED ← |
| 0.0086±0.0005 OUR AVERAGE | | | | | |
| 0.007 ±0.002 | ⁸ CORDEN | 75 | DBC | $K^- d$ 1.4–1.8 GeV/c | |
| 0.0085±0.0006 | ⁹ MAST | 73 | MPWA | $K^- p \rightarrow \Sigma\pi\pi$ | |
| 0.010 ±0.0015 | BARBARO-... | 69B | HBC | $K^- p$ 0.28–0.45 GeV/c | |

⁸ Much of the $\Sigma\pi\pi$ decay proceeds via $\Sigma(1385)\pi$.

⁹ Assumes $\Gamma(N\bar{K})/\Gamma_{\text{total}} = 0.46$.

NODE=B038;LINKAGE=F
 NODE=B038;LINKAGE=E

$\Gamma(\Lambda\gamma)/\Gamma_{\text{total}}$

| VALUE (units 10^{-3}) | EVTS | DOCUMENT ID | TECN | COMMENT | Γ_8/Γ |
|--|------|-------------|------|---|----------------------------|
| 8.5±1.5 OUR ESTIMATE | | | | | NODE=B038R4 NODE=B038R4 |
| 8.8±1.1 OUR FIT | | | | | → UNCHECKED ← |
| 8.8±1.1 OUR AVERAGE | | | | | |
| 10.7±2.9 ^{+1.5} _{-0.4} | 32 | TAYLOR | 05 | CLAS $\gamma p \rightarrow K^+ \Lambda\gamma$ | |
| 10.2±2.1±1.5 | 290 | ANTIPOV | 04A | SPNX $pN(C) \rightarrow \Lambda(1520)K^+N(C)$ | |
| 8.0±1.4 | 238 | MAST | 68B | HBC Using $\Gamma(N\bar{K})/\Gamma_{\text{total}} = 0.45$ | |

$\Gamma(\Sigma^0\gamma)/\Gamma_{\text{total}}$

| VALUE | DOCUMENT ID | TECN | COMMENT | Γ_9/Γ | |
|------------------------------|--------------------|------|---------|------------------------|----------------------------|
| 0.0195±0.0034 OUR FIT | | | | | NODE=B038R5 NODE=B038R5 |
| 0.02 ±0.0035 | ¹⁰ MAST | 68B | HBC | Not measured; see note | |

¹⁰ Calculated from $\Gamma(\Lambda\gamma)/\Gamma_{\text{total}}$, assuming SU(3). Needed to constrain the sum of all the branching ratios to be unity.

NODE=B038;LINKAGE=C

$\Lambda(1520)$ REFERENCES

| | | | | | |
|--------------------------|-----------|------------------------|---|--------------------------|-------------|
| WIELAND | 11 | EPJ A47 47 | F. Wieland <i>et al.</i> | (ELSA SAPHIR Collab.) | REFID=53763 |
| QIANG | 10 | PL B694 123 | Y. Qiang <i>et al.</i> | (DUKE, JEFF, PNPI, GWU+) | REFID=53557 |
| TAYLOR | 05 | PR C71 054609 | S. Taylor <i>et al.</i> | (JLab CLAS Collab.) | REFID=50670 |
| Also | | PR C72 039902 (errata) | S. Taylor <i>et al.</i> | (JLab CLAS Collab.) | REFID=50978 |
| ANTIPOV | 04A | PL B604 22 | Yu.M. Antipov <i>et al.</i> | (IHEP SPHINX Collab.) | REFID=50291 |
| PDG | 82 | PL 111B 1 | M. Roos <i>et al.</i> | (HEL5, CIT, CERN) | REFID=41167 |
| BARBER | 80D | ZPHY C7 17 | D.P. Barber <i>et al.</i> | (DARE, LANC, SHEF) | REFID=31754 |
| GOPAL | 80 | Toronto Conf. 159 | G.P. Gopal | (RHEL) IJP | REFID=31755 |
| BARLAG | 79 | NP B149 220 | S.J.M. Barlag <i>et al.</i> | (AMST, CERN, NIJM+) | REFID=31753 |
| ALSTON-... | 78 | PR D18 182 | M. Alston-Garnjost <i>et al.</i> | (LBL, MTHO+) IJP | REFID=31751 |
| Also | | PRL 38 1007 | M. Alston-Garnjost <i>et al.</i> | (LBL, MTHO+) IJP | REFID=31752 |
| CAMERON | 77 | NP B131 399 | W. Cameron <i>et al.</i> | (RHEL, LOIC) IJP | REFID=31749 |
| GOPAL | 77 | NP B119 362 | G.P. Gopal <i>et al.</i> | (LOIC, RHEL) IJP | REFID=31750 |
| MAST | 76 | PR D14 13 | T.S. Mast <i>et al.</i> | (LBL) | REFID=31748 |
| CORDEN | 75 | NP B84 306 | M.J. Corden <i>et al.</i> | (BIRM) | REFID=31747 |
| BERTHON | 74 | NC 21A 146 | A. Berthon <i>et al.</i> | (CDEF, RHEL, SACL+) | REFID=31745 |
| MAST | 73 | PR D7 3212 | T.S. Mast <i>et al.</i> | (LBL) IJP | REFID=31744 |
| MAST | 73B | PR D7 5 | T.S. Mast <i>et al.</i> | (LBL) IJP | REFID=32035 |
| CHAN | 72 | PRL 28 256 | S.B. Chan <i>et al.</i> | (MASA, YALE) | REFID=31742 |
| BURKHARDT | 71 | NP B27 64 | E. Burkhardt <i>et al.</i> | (HEID, CERN, SACL) | REFID=31738 |
| KIM | 71 | PRL 27 356 | J.K. Kim | (HARV) IJP | REFID=31740 |
| Also | | Duke Conf. 161 | J.K. Kim | (HARV) IJP | REFID=31741 |
| Hyperon Resonances, 1970 | | | | | |
| BARBARO-... | 69B | Lund Conf. 352 | A. Barbaro-Galtieri <i>et al.</i> | (LRL) | REFID=31735 |
| Also | | Duke Conf. 95 | R.D. Tripp | (LRL) | REFID=31736 |
| Hyperon Resonances 1970 | | | | | |
| BURKHARDT | 69 | NP B14 106 | E. Burkhardt <i>et al.</i> | (HEID, EFI, CERN+) | REFID=31733 |
| MAST | 68B | PRL 21 1715 | T.S. Mast <i>et al.</i> | (LRL) | REFID=31731 |
| SCHEUER | 68 | NP B8 503 | J.C. Scheuer <i>et al.</i> | (SABRE Collab.) | REFID=31732 |
| DAHL | 67 | PR 163 1377 | O.I. Dahl <i>et al.</i> | (LRL) | REFID=20321 |
| DAUBER | 67 | PL 24B 525 | P.M. Dauber <i>et al.</i> | (UCLA) | REFID=31729 |
| UHLIG | 67 | PR 155 1448 | R.P. Uhlig <i>et al.</i> | (UMD, NRL) | REFID=31730 |
| BIRMINGHAM | 66 | PR 152 1148 | M. Haque <i>et al.</i> | (BIRM, GLAS, LOIC, OXF+) | REFID=31692 |
| ARMENTEROS 65C | PL 19 338 | | R. Armenteros <i>et al.</i> | (CERN, HEID, SACL) | REFID=31725 |
| MUSGRAVE | 65 | NC 35 735 | B. Musgrave <i>et al.</i> | (BIRM, CERN, EPOL+) | REFID=31691 |
| WATSON | 63 | PR 131 2248 | M.B. Watson, M. Ferro-Luzzi, R.D. Tripp | (LRL) IJP | REFID=31723 |
| FERRO-LUZZI | 62 | PRL 8 28 | M. Ferro-Luzzi, R.D. Tripp, M.B. Watson | (LRL) IJP | REFID=31721 |

NODE=B038